A CRETACEOUS ECHINOID WITH FALSE TEETH

by PORTER M. KIER

ABSTRACT. The teeth described in 1911 in a specimen of *Conulus subrotundus* Mantell from the Turonian Middle Chalk are from a Recent echinoid. No lantern was present in adults in *Conulus* or probably in other members of the families Conulidae Lambert or Galeritidae Gray. The structures previously thought to be lantern support structures (auricles) are considered to be related in function to the large buccal plates. Instead of being degenerating structures as previously thought, they increase in size in later species.

ALTHOUGH echinoid workers generally have not become very aroused in their controversies, two subjects have caused considerable heat: the question whether *Bothriocidaris* was an echinoid (now resolved in the affirmative), and whether or not *Conulus* had teeth. *Conulus* is one of the better-known and more 'popular' echinoid genera in Europe because of its abundant occurrence in the Chalk. It was assumed that it was toothed because it is an holectypoid, and most holectypoids have teeth. Forbes (1850, p. 3) described and figured what he considered to be teeth and jaws in *Conulus* and subsequent authors (see Hawkins, 1911, p. 70 for a complete history) accepted his opinion until Duncan (1884, p. 11) in a paper considered to be dogmatic by those opposed to his views, disagreed with the previous workers and contended that the objects they thought to be jaws were imaginary, or merely grooves made by a tool in the soft matrix within the peristome. After this strong rebuttal the proponents for a lantern retreated and most subsequent workers until 1911 accepted that it was lanternless. However, Hawkins (1911, p. 71) found a specimen of *Conulus subrotundus* Mantell, in the British Museum with four teeth protruding from its peristome. He was unable to find any jaws. Since this time it has been assumed by all echinoid workers that *Conulus* and the rest of the genera of the families Conulidae Lambert and Galeritidae Gray had jaws and teeth when adults.

As part of a study of the lantern in echinoids, I was particularly anxious to see a lantern in *Conulus* and dissected hundreds of specimens of *C. albogalerus* Leske. This is a relatively easy task with an air abrasive machine because of the soft chalk matrix. However, no fragments of a lantern or teeth were found in any of them. Inasmuch as the peristome is very small in diameter, bits of the lantern would have been expected to have been retained in the test. Furthermore, I dissected a specimen of *C. albogalerus* in which all the buccal plates were still preserved in place but there were no fragments of a lantern. These plates have been found on only a handful of the thousands of specimens of this species that have been collected. Obviously the slightest movement of the specimen after death caused these plates to become separated, and if a lantern had been present in this specimen it would be expected that parts of it would still be there. Hawkins also dissected hundreds of *C. albogalerus* and never found any lantern fragments. But the teeth in the specimen of *C. subrotundus* described by Hawkins were positive evidence that could not be ignored. It could not be assumed that four teeth were washed into a specimen all with their tips extending outward. But if it had teeth, why were no pyramids preserved? Hawkins noted that it would not be possible for the

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pyramids to slip out through the small peristome and have the teeth remain. He suggested that perhaps the pyramids were noncalcified—a conclusion with which he was not satisfied but could suggest no other alternative. Restudy of this specimen has revealed the solution to this dilemma—the teeth do not belong to the specimen. Some person excavated a cavity inside the peristome and inserted four Recent teeth mixed with some cement into the cavity.

The following evidence indicates that the teeth did not belong to the echinoid:

1. The matrix around the teeth is much softer than the matrix in the rest of the test. This difference was readily apparent when the air abrasive machine was used. The machine had very little effect on the area away from the peristome but one blast of abrasive in the area around the teeth removed considerable matrix. As is well known to anyone who has worked with chalk fossils, the matrix in Middle Chalk specimens is commonly quite hard as opposed to Upper Chalk specimens. The matrix in this specimen is typical of the Middle Chalk except in the cavity where the teeth lie. Here it is not only very soft and crumbly but also much coarser (Pl. 93, fig. 5) in texture. Dr. Maurice Black, an authority on chalk, examined this material and concluded that it was not chalk. Only a few coccoliths were visible and he suggested that these had probably come from the adjacent chalk matrix. He surmised that this material around the teeth was probably some type of cement (perhaps dental). A. G. Brighton, curator of the Sedgwick Museum, Cambridge, reports (personal communication, 1968) that there have been many chalk 'fossils' faked by individuals anxious to sell specimens to museums, or interested collectors. Commonly, the hoaxer mixes up a matrix of crushed chalk or lime, and some type of cement and inserts into it a Recent specimen and then offers it for sale as a 'perfectly preserved Cretaceous fossil with color markings'.

After hearing about this forgery in *Conulus*, Peter J. Moulds of Queen Mary College, London, examined some specimens of Chalk echinoids which had been puzzling him and discovered that at least two of them are forgeries. According to his letter to me (1968): 'one block of Chalk with several spines enclosed had an entirely different test added later. This test had been sawed in half in order to fit to the block! I suppose the main reason for these forgeries was to increase the interest and thus the value (financial that is—many of the museum specimens have their original price on them).'

2. The quality of the preservation of the teeth indicates that they are from a Recent echinoid and not fossil. All the teeth have a glistening, porcellanous sheen (Pl. 94, fig. 1) which I have never seen to this extent in a fossil tooth. Although a slight sheen may rarely be preserved on an extremely well-preserved fossil tooth, it is never as pronounced as on these teeth. Furthermore, the open meshwork of the microstructure of the tooth is not permineralized as it would be in a fossil (pl. 93, fig. 4). The open interstices in the tooth are normally filled with secondary calcite in a fossil tooth but in this specimen they are not. Furthermore, the upper part of the teeth are soft and fibrous with the asbestos-like structure found in a Recent tooth but never in a fossil.

The teeth are too small for a carbon-14 analysis, but Dr. Kenneth Towe pointed out that Weber and Raup (1968, p. 42) have shown that skeletal magnesium is lost early in diagenesis and that Recent echinoids therefore have a higher magnesium carbonate content than fossil ones. Dr. Towe suggested that if these teeth were Recent, they should contain a larger amount of $MgCO_3$ than the rest of the fossil. He analyzed (using X-ray diffraction) a portion of one of the teeth, part of the test of a *Conulus subrotundus*,

and for comparison purposes a Recent tooth, and a tooth known for certain to have come from a Chalk species, *Phymosoma koenigi* (Mantell). The fragment of the test of *C. subrotundus* and the tooth from *P. konigi* contained no $MgCO_3$, whereas the tooth of the Recent echinoid contained 6–8 mol per cent $MgCO_3$ and the tooth from the *Conulus* contained 3–4 mol per cent. The fact that the *Conulus* tooth contained $MgCO_3$ and the specimen from which it was supposed to have come contained none indicates that the tooth is not from the *Conulus*.

3. The fact that all the teeth are broken and that all these broken ends are on the ends of the tooth in the matrix must arouse considerable suspicion as to their authenticity. It is very doubtful that any natural forces could break the inner ends of all four teeth and still permit their outer ends to protrude unbroken from the echinoid test. Echinoid teeth are quite strong and any force which broke all of them would surely disassociate them enough so they would not all remain with their tips still protruding out the peristome. Probably the hoaxer, in order to avoid drilling a much deeper hole into the test, simply broke part of each tooth and inserted the broken ends into the hole.

4. The teeth themselves are unlike any found before in an irregular echinoid. Their keels are far too narrow and sharp. Hawkins (1911, p. 72) stated that the teeth were very like those found in *Camerogalerus cylindricus* (Lamarck), but the tooth of *Cam. cylindricus* has a much broader keel, tapering from the edge of the keel to the sides of the tooth, whereas the teeth in the *Conulus* have the sides of the keel parallel to each other. Although, Durham and Melville (1957, text-fig. 1B) show a narrow sharp keel in *Holectypus depressus* (Leske) I have made further preparations of the specimen they figured and have found that the tooth has a broad keel very much like that in *Pygaster* as described by Melville (1961). I know of no irregular echinoid tooth resembling the teeth attributed to *Conulus*.

5. When Hawkins first saw the specimen he noted that someone had enlarged the peristome by cutting. Presumably, he thought that this enlarging was done in an effort to expose the teeth, but probably the hoaxer was unable to fit all the teeth in the small

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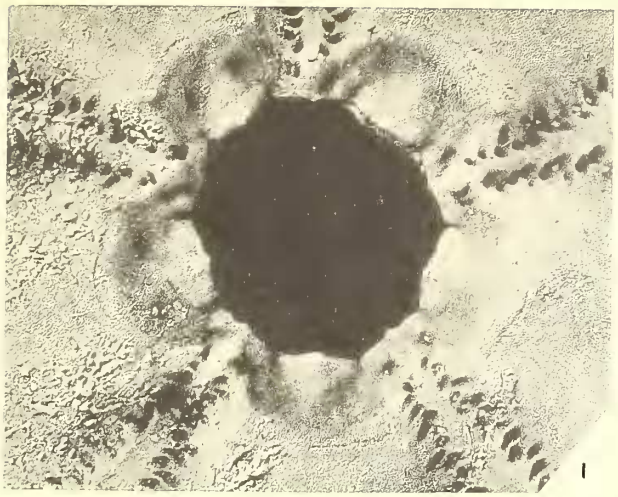
EXPLANATION OF PLATE 93

Figs. 1–3. View of the interior region around the peristome in three species of *Conulus* showing the thickened basicoronal plates which have been considered to be auricles. The pictures are arranged stratigraphically with the earliest species, *Conulus castanea* (Brongniart) from the Cenomanian at the base (fig. 3), the Turonian *C. subrotundus* Mantell in the middle (fig. 2) and the latest, the Senonian *C. albogalerus*, at the top (fig. 1). Note that the structures formerly considered to be auricles are more pronounced in *C. albogalerus* than in the older species contradicting the assumption that these structures are degenerating lantern supports. 1, *Conulus albogalerus* Leske, Upper Chalk, Gravesend, Sedgwick Museum B. 3623, Kent, ×8. 2, *Conulus subrotundus* Mantell, Middle Chalk, *Orbirhynchia cuvieri* zone, Hitchin, Herts., Sedgwick Museum B. 408, ×10. 3, *Conulus castanea* (Brongniart), Bed 13 Meyer, Beer Head, Devon, Sedgwick Museum B. 7577, ×13.

Fig. 4. Section through tooth considered to be Recent but found in specimen of *Conulus subrotundus* figured in fig. 6. Note the microstructure which is normally visible on a Recent tooth but not on a fossil, ×37.

Figs. 5, 6. *Conulus subrotundus* Mantell. Specimen which H. L. Hawkins found in the British Museum (Natural History) with four teeth protruding from the peristome. He cut the specimen in half and excavated the area around the peristome but found no fragments of a lantern. Note the coarser matrix around the teeth. Label for specimen, B.M. E 10743, only states Upper Chalk which is presumably an error because this species is known only in the Middle Chalk. Fig. 5, ×6·5; fig. 6, ×2.



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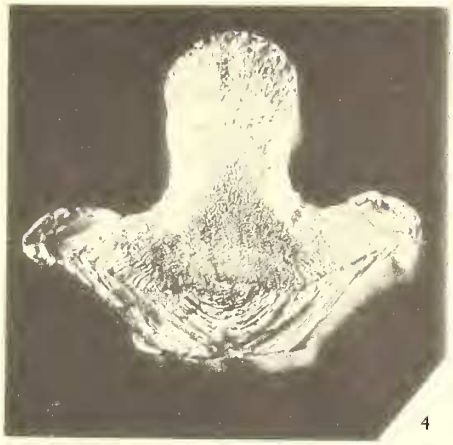

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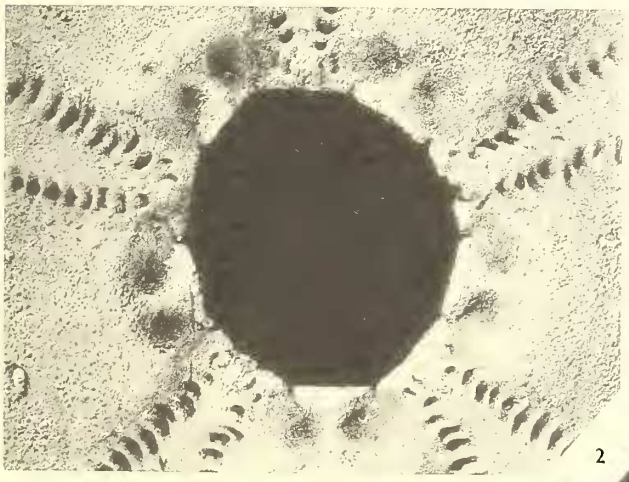

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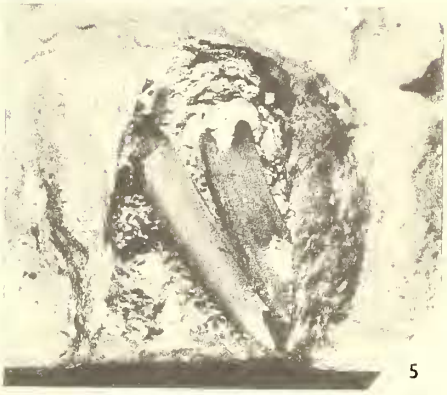

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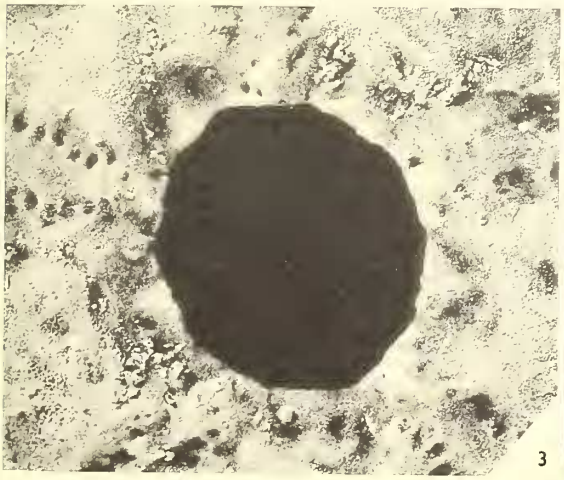

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peristome and just widened it enough to accommodate them—which might also explain why he inserted only four teeth.

6. The presence of teeth but absence of any of the numerous parts of the jaws is nearly impossible to explain. The peristome of *Conulus* is so small in diameter that the jaws could hardly have slipped out around the teeth without the teeth slipping out also. Commonly, the teeth are the first to slip out of the test after the echinoid dies. They are connected to the jaws by far less tissue (they must be able to move down the dental slide as the echinoid grows) than the pyramids are to each other. I have found very few teeth in comparison to the number of jaws during my excavations of fossil echinoids, and I have never found teeth without there also being part of the jaws.

The only direct evidence of a lantern in *Conulus* was the presence of the teeth described above. Now that they are shown to be fraudulent we must examine again the problem as to whether *Conulus*, and for that matter any of the members of the Conulidae or Galeritidae, had a lantern. Recent workers (Hawkins 1911, 1917, 1934, Mortensen 1948, p. 43, Wagner and Durham 1966, p. 455) have considered that the thickened structures (Pl. 93, figs. 1–3) in the interambulacra at the edge of the peristome were auricles (lantern support structures). Although Hawkins's illustration (1917, pl. 28, fig. 1, reproduced in the Treatise, Wagner and Durham 1966, fig. 331, 4*c*) does depict a structure strongly resembling auricles, this figure is highly stylized and gives a misleading impression of the structure. In this figure the auricle-like features are exaggerated.

Although the thickened basicoronal plates do resemble auricles or apophyses, they differ from them in an important character. Auricles or apophyses consist of processes which rise upward from the basicoronal ambulacral or interambulacral plates. These tabs may be thick or thin but invariably they rise far above the general level of the basicoronal plates. No such tabs are present in *Conulus*. Although minute knobs are present on the edge of the thickened basicoronal plates in large specimens of some species of *Conulus*, they are absent from most species and are far too small to be considered as auricles.

Many workers including Hawkins (1911, p. 72) have considered that the 'auricles' in *Conulus* were degenerate structures and that their lack of strong development resulted from the fact that the lantern and its supporting structures were gradually being lost through time. If this were the case it would be expected that these 'auricles' would be less pronounced in succeeding species, but just the opposite is the case. This thickening of the basicoronal plates becomes more pronounced in later species. The earliest *Conulus* in which I have been able to expose the interior is *C. castanea* (Brongniart) from the Cenomanian. The basicoronal plates are slightly thickened (Pl. 93, fig. 3) and two slight depressions are present in each of these thickened interambulacra. In the Turonian *C. subrotundus* Mantell the interambulacral plates are more thickened (Pl. 93, fig. 2) the paired depressions deeper and the angle of their faces greater. Finally in the Senonian *C. albogalerus* Leske all these features (Pl. 93, fig. 1) are even more pronounced. Therefore, this thickening cannot be considered a degenerating character.

The position and character of these structures suggest that they are related to the function of the ten plates around the peristome which are considered to be buccal plates. These plates are interpreted as buccal plates rather than basicoronal plates because they are not attached to the rest of the test by normal sutural tissue as is indicated by their absence in most specimens (they have only been found in *C. albogalerus* but presumably